However, National Project of Organic Farming (NPOF) sanctioned w.e.f. 1.10.2004 has project outlay of Rs. 57.05 crores for 10th Plan Period. During 2004-05, there was an expenditure of Rs. 4.50 crores and has an outlay of Rs. 27.00 crores for 2005-06.

(d) Under the National Project on Organic Farming, financial assistance is being provided *inter-alia* for capacity building through appointment of service providers, setting up of commercial production units of various organic input like fruits and vegetable waste compost, biofertilizer, vermiculture hatcherie etc., organizing training on certification/ inspection and input production technology, field demonstrations on organic inputs including biogas slurry, setting up of model organic farms, promotion, extention and market development of organic produce.

To increase the export of organic products, Ministry of Commerce, under National Project of Organic Production has developed National Standards for Organic Products and accreditation/certification system for appointing inspection and certification agencies, established equivalency with European Union (EU)/International Federation for Organic Movement (IFOAM) apart from organizing awareness programmes, training programmes and data management.

Research on pest resistance of Bt. Cotton

490. SHRI EKANATH K. THAKUR: Will the Minister of AGRICULTURE be pleased to state:

(a) whether, according to a study by Central Institute for Cotton Research (CICR), a few years down the line, Bt. cotton might die a natural death at the hands of American bollworm, the pest it is supposed to resist;

(b) whether it is a fact that the CICR has developed a model that predicts exactly how many years it would take the notorious pest to become completely resistant to Bt. cotton; and

(c) if so, the steps Government propose to take to arrest its impending decline?

THE MINISTER OF STATE IN THE MINISTRY OF AGRICULTURE (DR. AKHILESH PRASAD SINGH): (a) The study conducted by Central Institute for Cotton Research (CICR) showed that the American bollworm will develop resistance to Bt-cotton after a few years depending mainly

on the extent of area under Bt-Cotton in the country. With the current rate of increase in the area under Bt-cotton, it is likely to take about 11-12 years for the pest to develop resistance to Bt-Cotton, if appropriate resistance management strategies are not properly implemented. However, with implementation of proper strategies as suggested by CICR, it is possible to delay resistance by at least 30-40 years, if not more.

(b) Yes, a stochastic model 'Bt-Adapt' was developed to simulate the rate of resistance development of *H. armigera* to Cry1Ac under Indian farming condition. Full details of the software and results of the prediction modelling study have been published in 'Current Science' in October 2004. The model integrates genetic and ecological parameters of *H. armigera* in relation to its response to the Cry1Ac expressing Bt cotton. The model can predict the time that would take for bollworm to develop resistance in different cotton-growing districts of the country, based on the input statistics of area under Bt-cotton in each of the districts, or even the proposed area to be cultivated under Bt-cotton.

Simulation analysis showed that relative survival rate of the Cry1Ac resistant homozygous (RR), heterozygous (RS) and homozygous susceptible (SS) *H. armigera* genotypes on Bt-cotton, was the most important factor influencing resistance development. In the order of significance, the other factors that had the greatest impact on resistance development were, the relative proportion of area under Bt-cotton, dominance of the resistant allele and initial frequency of resistant alleles in field populations. The extent of population reduction in Bt-cotton and non-Bt crop due to pest control, was found to have a significant impact on the rate of resistance development.

(c) The Indian Council of Agricultural Research (ICAR) has initiated a net-working project in 2004, to carefully monitor resistance development in all the 9 cotton growing States of the country and also to scientifically analyze all factors that contribute to resistance development. The national net-working group has been given the task of developing resistance management strategies from time to time every year and disseminate them to all the stakeholders, including the Genetic Engineering Approval Committee (GEAC), the State agricultural universities, Government institutions, farmers, Non-Governmental Organisation (NGO), etc. So far based on the simulation analysis, using the 'Bt-Adapt' model, and scientific

data available thus far, CICR has proposed some important resistance management strategies to the GEAC. The strategies place emphasis on reducing populations of *H. armigera* that survive Bt. cotton and enhancement of area of alternate host crop that are as attractive as cotton to *H. armigera,* to be used as trap crop or intercrop refuges. If proper pest management measures are followed to ensure that at least 90% of the surviving larvae of the American bollworms in Bt-cotton fields, are killed with biopesticides, resistance can be delayed to 45 years even with 40% area under Bt-cotton. The following strategies have been proposed to the GEAC for approval and implementations so as to ensure that resistance is delayed for a much longer time. The strategies, that would enable extending the usefulness of Bt technology would be:—

(i) Use eco-friendly methods such as cultural control or hand-picking of surviving bollworms in Bt cotton fields. Deep-ploughing of fields immediately after Bt-cotton harvest to destroy resistant pupae.

(ii) Biopesticides that are neem based or HaNPV (virus) were found to be more effective on larvae surviving on Bt-cotton because of their slower growth as compared to those on the conventional non-Bt cotton. Hence these would be useful to manage younger larvae on 60-90 days old crop. Alternatively, eco-friendly insecticides such as spinosad, emamectin benzoate, novaluron or Indoxacarb can be used on 90 and 120 days old crop to reduce populations of resistant inset genotypes.

(iii) Use of attractive synchronous alternate host crops such as marigold, sunflower, chillies etc. for *H. armigera* which could be used as intercrop or trap crop refuges.

(iv) Use alternate genes that do not share common resistance mechanisms as that of Cry1Ac, in transgenic plants either in rotation or alternation or mixtures such as the dual-gene based Bt-cotton varieties.

Sale of Spurious Bt. Cotton seeds

491. SHRI EKANATH K. THAKUR: Will the Minister of AGRICULTURE be pleased to state:

(a) whether it is a fact that spurious seeds of Bt. Cotton have flooded the markets of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and other cotton growing areas of the country; and